DOCUMENT RESUME

ED 439 662 HE 032 740

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TITLE Initial Employment Report, 1998: Follow-Up of 1997 Physics and Astronomy Degree Recipients. AIP Report.
INSTITUTION American Inst. of Physics, College Park, MD. Education and Employment Statistics Div.
REPORT NO AIP-R-282-21
PUB DATE 1999-12-00
NOTE 14p.; For the 1998 Physics and Astronomy report, see HE 032 741.
AVAILABLE FROM American Institute of Physics, One Physics Ellipse, College Park, MD 20740-3843. Tel: 301-209-3070; e-mail: stats@aip.org. For full text: http://www.aip.org/statistics/trends/emptrends.htm.
PUB TYPE Numerical/Quantitative Data (110) -- Reports - Descriptive (141)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Astronomy; Bachelors Degrees; Doctoral Degrees; *Education Work Relationship; *Employment Experience; *Employment Statistics; Enrollment Trends; *Graduate Study; Higher Education; Masters Degrees; Occupational Information; *Outcomes of Education; *Physics
IDENTIFIERS American Institute of Physics

ABSTRACT

This report follows up the employment status of 1997 physics and astronomy degree recipients. The report notes that: (1) only 2 percent of 1997 doctoral degree recipients were unemployed in the winter of 1998; this is down from a recent high of 6 percent for the class of 1993; (2) half of new physics Ph.D.s in the class of 1997 accepted permanent positions; a majority of these positions were in the industrial sector; (3) the majority of new Ph.D.s employed in permanent positions expressed the view that they were working in an area that was not primarily physics based; in contrast, the majority of new Ph.D.s in postdoctoral and other temporary positions were employed primarily in physics; (4) more than half of students leaving with master's degrees entered the work force, 62 percent of these were employed in industry, and 75 percent view their positions as related to physics; (5) half of all 1997 bachelor's degree recipients enrolled in graduate school, with the majority entering a physics graduate program; and (6) over 95 percent of physics bachelor's degree recipients entering graduate school received research assistantships, teaching assistantships, or fellowships. Tables and figures summarize the data. (CH)

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AIP Pub No. R-282.21

December 1999

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1998 Initial Employment Report: Follow-Up of 1997 Physics and Astronomy Degree Recipients

Highlights

- Only 2% of the PhD class of 1997 were unemployed and seeking employment in the winter of 1998. This is down from a recent high of 6% for the class of 1993. **(Figure 1)**
- Half of the new physics PhDs in the class of 1997 accepted permanent positions. This is similar to the class of 1996 and represents a stabilization after 3 years of sharp increases. The majority of these permanent positions are, as before, in the industrial sector. **(Figure 2)**
- The majority of the new PhDs employed in permanent positions expressed the view that they were working in an area that was not primarily physics. This does not mean, however, that their positions involve little or no physics. By comparison, the vast majority of new PhDs in postdocs and other temporary positions are employed primarily in physics. **(Figure 3)**
- Over half of the students exiting their current department with a physics masters degree entered the work force. The majority (62%) of these employed masters are working in industry and three-quarters view that position as related to physics. **(Figure 12 & 13)**
- Half of the physics bachelor's class of 1997 chose to enroll in graduate school, with the majority entering a physics graduate program **(Figure 8).** Of those bachelors entering the job market, 70% were employed in the industrial sector with a median annual salary of $37,000. **(Figure 10)**
- Support for physics bachelor's recipients choosing to enter physics graduate study remains strong with over 95% reporting that they received RA's, TA's or fellowships. **(Table 1)**

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Member Societies: The American Physical Society•Optical Society of America•Acoustical Society of America•The Society of Rheology•American Association of Physics Teachers American Crystallographic Association•American Astronomical Society•American Association of Physicists in Medicine•American Vacuum Society•American Geophysical Union

Recent years have witnessed some dramatic changes in the post-degree outcomes and job market opportunities for physics graduates, especially for PhD recipients. Unemployment rates for degree recipients at all levels are the lowest they have been for more than a decade. Since the early 1990s, the proportion of new physics doctorates accepting potentially permanent positions has more than doubled. A larger percent of physics bachelors are accepting technically-related positions in industry, with a corresponding rise in starting salaries. These shifts in initial employment for recent degree recipients are a result of many factors, most stemming from the strong US economy but also some relating to shifts in long-term career goals of the graduates.

The Initial Employment Report is based on an annual survey of physics degree recipients conducted approximately six months after the end of the academic year in which they received their degrees. We asked the 762 physics and 69 astronomy departments to provide current addresses for graduates at all degree levels (1).

New PhDs

During the 1996-97 academic year there were 1,385 physics PhDs conferred at the 182 departments granting physics doctorates in the US. Data on 80% of these PhDs were obtained by either direct response to our mail survey (41%) or, in the case of non-responding doctorates, by contacting their thesis advisors (39%). The data gathered from advisors only addressed the students' basic employment outcomes.

(1) For detailed information on academic enrollments and degrees conferred at US physics and astronomy departments, consult the AIP Enrollments and Degrees Report.

The class of 1997 spent a median of six full-time equivalent years of graduate study to complete their degree and included 12% women and 45% foreign citizens. Respondent and departmental data indicate that approximately 9% of the US citizens and 21% of the non-US citizens accepted initial employment outside the US. The figures that follow represent initial employment outcomes for physics PhD recipients remaining in the United States, regardless of their citizenship.

The proportion of new doctorates who were unemployed in the US at the time of the survey was 2% **(see Figure 1).** This is down from a recent high of 6% for the classes of 1993 and 1994. Furthermore, the proportion accepting temporary positions is also substantially down from that reported in the early 1990's. About half of these individuals indicated that they were working in a temporary position because a suitable permanent position was not available.

Figure 1. US employment status of physics PhDs in the winter following their degree, class of 1996-97.

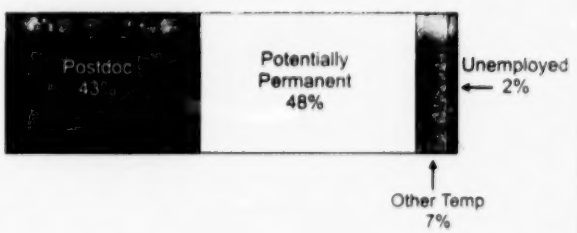

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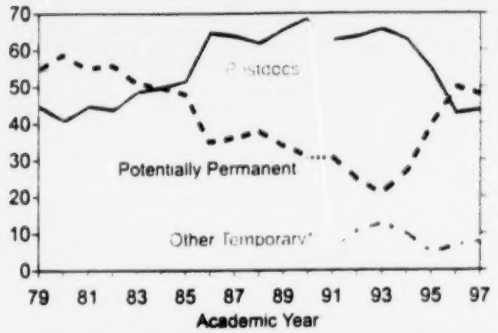
Figure 2. Trend data on the type of US employment secured by physics PhD's in the winter following their degree, 1979-1997.



*In 1991, the survey questionnaire was changed to measure "other temporary" employment as a separate category.

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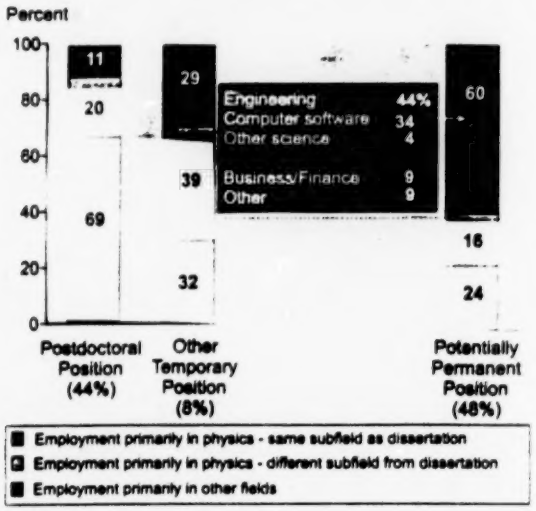
The decline in the proportion of new degree recipients taking temporary positions, especially postdocs, is balanced by an extremely rapid rise in the proportion of new degree recipients accepting potentially permanent positions **(see Figure 2)**.

This shift in initial employment indicates not only an interest from industry in hiring physicists and other scientifically trained PhDs, but also an increased willingness on the part of new PhDs to consider non-academic employment. This shift in initial employment away from postdocs may also be influenced by changes in degree recipients' expectations. It may also reflect a change in perception, that is, being a physicist is not necessarily synonymous with being employed in a research university.

Finally, some of the change seen in the overall initial employment comes from a higher proportion of foreign citizens accepting non-postdoctoral positions than in the past. Due to visa restrictions, new PhDs who were foreign citizens had their employment options primarily restricted to postdoctoral positions. Changes in US immigration laws have allowed a larger proportion of non-citizens to obtain permanent resident status and subsequently broaden their employment choices.

Figure 3. Primary field of employment and type of US position secured by physics PhDs in the winter following their degree, class of 1996-97.



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More than two-thirds of the individuals accepting postdoctoral positions not only remain in the field of physics but also are working primarily within their field of doctoral specialization **(see Figure 3)**. In contrast, degree recipients securing potentially permanent positions take on both a different employment profile and often experience a change in focus. Of those accepting permanent positions, a substantial and increasing proportion report that they are employed in a position that they don't consider to be primarily in physics. The categorization of whether or not someone is working in the field of physics is not clear-cut. Those indicating physics need not be doing physics exclusively nor are those employed in related fields doing no physics at all.

As has been historically true, the majority of postdocs are employed in the university or government sector **(see Figure 4)**. However employment sectors have been changing for those accepting permanent positions. In the late 1980's about 40-50% of the new degree recipients who accepted permanent positions were employed by the industrial sector. A decade later that proportion is now around 70%.

The median annual salary for a new physics PhD differs greatly depending on the type of position and employment sector. The industrial sector offers the highest salaries, followed by positions in the government and finally academic institutions **(see Figure 5)**. In general salaries for doctorate recipients have been going up in recent years for all sectors. One exception had been salaries for university postdocs, which had been fairly stable at a median of around $32,000 for a number of years. However, the median salary for 1997 postdocs was up over 6% to $34,000, which could be in part a by-product of fewer students pursuing that type of post-degree employment. In any event, physics postdocs earn a higher salary than postdocs in most other disciplines.

Figure 4. Employment sector and type of position secured by US employed physics PhDs in the winter following their degree, class of 1996-97.

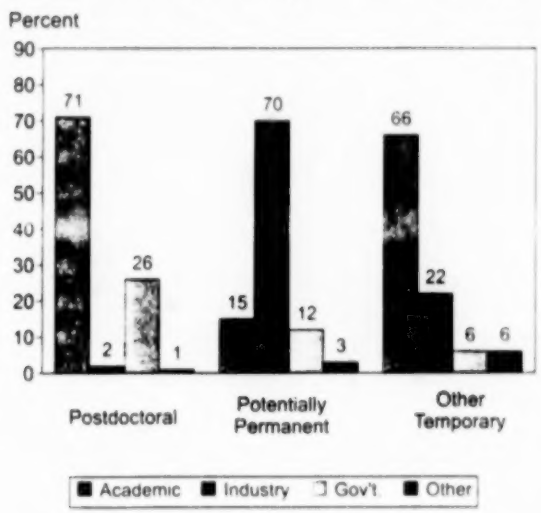

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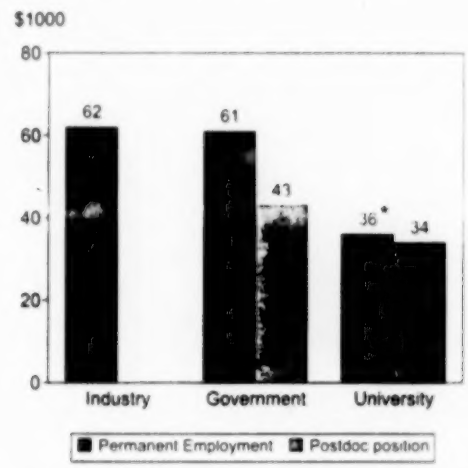
Figure 5. Median full-time annual salary and type of US position secured by physics PhD's in the winter following their degree, class of 1997.



*Includes PhDs with salaries based on both 9-10 month and 11-12 month salary contracts at four-year colleges and universities.

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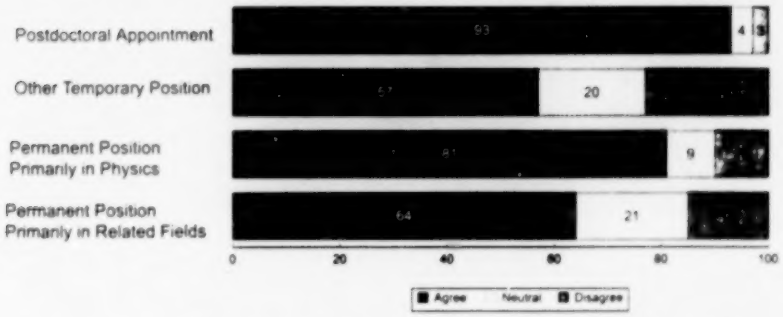
Figure 6. Ratings of professional challenge by type of US employment, physics PhD class of 1996-97.



Note: Respondents were asked to rate their agreement with the statement "My current position is professionally challenging" using a 5-point scale, where 1=Strongly Agree and 5=Strongly disagree. In the figure above, *agree* represents those respondents who chose 1 or 2 and *disagree* represents those who chose 4 or 5.

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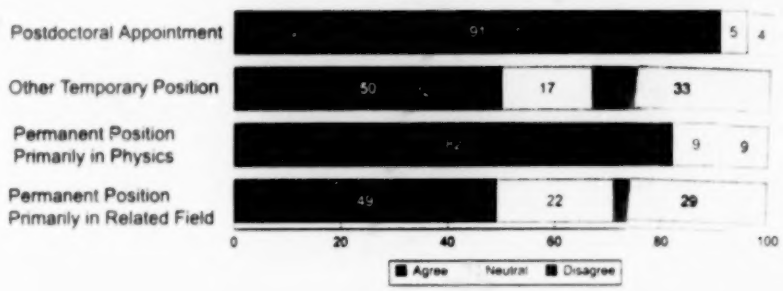
Figure 6 presents the responses of new PhD's as to whether they agreed or disagreed with the statement "My current position is professionally challenging". The majority of all physicists were in agreement with the statement. Individuals holding postdoctoral appointments reported the highest level of agreement this view. However, nearly one quarter of those in other temporary positions (not postdocs) reported that their positions were not professionally challenging.

Degree recipients were also asked to evaluate the statement "My current position is commensurate with my education and training" **(see Figure 7)**. While the majority agreed with the statement, there were a significant number of degree recipients who did not, reflecting weaknesses in the jobmarket. The degree recipients disagreeing with the statement were primarily those employed in other temporary positions and in permanent positions in related fields. It is not clear from this

Figure 7. Ratings of whether their current position is commensurate with their education by type of US employment, physics PhD class of 1996- 97.



Note: Respondents were asked to rate their agreement with the statement "My current position is commensurate with my education and training" using a 5-point scale, where 1 = Strongly Agree and 5 = Strongly disagree. In the figure above, *agree* represents those respondents who chose 1 or 2 and *disagree* represents those who chose 4 or 5.

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question whether the individuals disagreeing with the statement, especially those employed in related fields, consider themselves under-employed or if their response simply reflects the interdisciplinary nature of their work.

Bachelor's degree recipients

There were 3,826 physics bachelor's degrees awarded to the class of 1996-97. This group is highly mobile and departmental records are not uniformly good. We obtained 1,503 usable surveys in the winter following the academic year in which the students received their degrees. The degree class consisted of 7% foreign citizens and 19% women. The representation of women among physics bachelor's degree recipients has risen by 1% in each of the last two years.

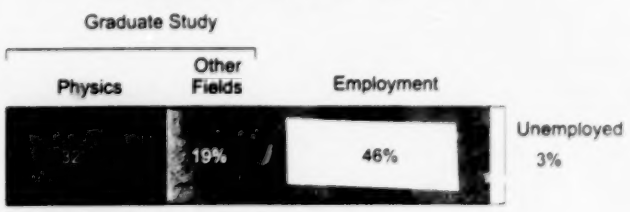
The overall initial post-degree outcomes for the physics bachelors are shown in **Figure 8**. Similar to the last couple of years, about half of the new physics bachelor's recipients choose to immediately continue their education at the graduate level. Almost two-thirds of this group continue to pursue physics studies. Engineering was the second most popular field, accounting for 15% of the students entering a graduate program.

Turning to the 49% of physics bachelors recipients who entered the job market after graduation, 46% secured some type of employment by the time the survey was conducted while only 3% were still unemployed at the time the survey was conducted. Of the employed bachelors, 12% indicated their positions were temporary, down from 17% the previous year. Individuals employed at colleges and universities reported the largest proportion of temporary positions; these were frequently one-year positions while waiting to begin graduate studies the following fall.

It is worth noting that among all degree recipients immediately entering the job market after receiving their degree, the majority (82%) indicated they had plans to pursue graduate studies in the future and a quarter were intending to enroll in the next academic year. Overall, about a quarter of these prospective graduate students said they planned to study physics.

The early careers of bachelors are volatile and their plans do not always match reality. With this in mind, degree recipients were asked to look back

Figure 8. Postbaccalaureate outcomes for physics bachelor's recipients as reported during the winter following their graduation, class of 1996-97.



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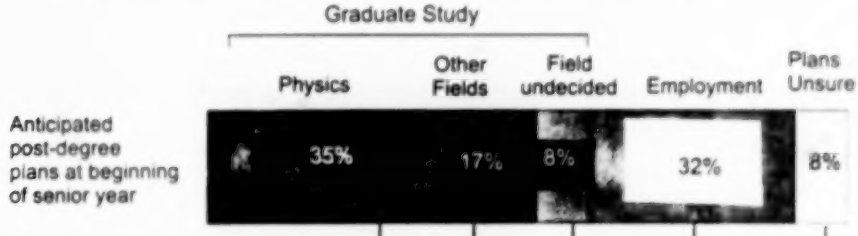
and describe the career paths they had originally intended to pursue when they began their final undergraduate year. These initial post-degree plans are compared with their actual post-degree outcomes in **Figure 9.** Students planning to continue in physics were more likely to stick with their original plan than those planning on switching to graduate study in other subjects. And although three-quarters of the students intending to enter the work force actually did so upon graduation, a sizable number (18%) diverted from that path in order to pursue graduate studies. Finally, half of the students whose postbaccalaureate plans were unsure at the start of the year ended up enrolled in a graduate program after graduation, the majority of them in physics.

Degree recipients who immediately enrolled in a graduate program were asked how well their undergraduate studies prepared them for graduate school. The vast majority (90%) felt that their undergraduate studies had adequately prepared them for graduate school. Students choosing to go on in other disciplines as well as those continuing in physics shared this perception equally. This reinforces the idea that an undergraduate physics degree is a solid foundation for a variety of career paths.

The graduate programs in which physics bachelor's recipients enrolled varied greatly by the discipline they chose. Students entering graduate physics programs were more likely to be enrolled in doctoral programs (70%) than those enrolled in other subjects (27%). This difference in disciplines and program types is probably responsible for differences in the type of financial support they receive. As shown in **Table 1**, virtually all students pursuing graduate study in physics received funding, with the proportion receiving fellowships increasing by 5% over the previous year. In contrast, 29% of the physics bachelors who pursued further studies in engineering needed to pay their own way, and that proportion rose even higher, to 42%, among students pursuing other disciplines.

Figure 9. Anticipated plans and postbaccalaureate outcomes for physics bachelor's recipients as reported during the winter following their graduation, class of 1996-97.



Postbaccalaureate outcomes	Physics	Other Fields	Field undecided	Employment	Plans Unsure
Physics Grad. Study	64	10	36	8	32
Grad. Study Other Subjects	7	55	33	10	18
Employment	28	32	29	75	48
Unemployed	1	3	2	7	2
	100%	100%	100%	100%	100%

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Table 1. Source of financial support for bachelor's recipients continuing on to graduate study, class of 1996-97.

	Subject of Graduate Study		
	Physics %	Engineering %	Other %
Teaching Assistantship	46	14	24
Research Assistantship	19	33	11
Fellowship	30	19	20
Self-financed*	4	29	42
Other	1	5	3

* Self-financed includes funds from other non-departmental employment, family, savings and loans.

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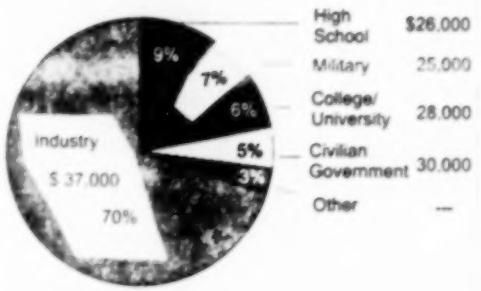
Industrial employment, the primary destination for physics bachelors going directly into the workforce, has been rising in recent years, and now constitutes 70% of all employment for physics bachelor's in the class of 1996-97. Coinciding with this rise in industrial employment is a substantial increase in the salaries reported by recent degree recipients in that sector. The $37,000 median industrial salary represented a 16% increase from the previous year and a 23% increase from 1994. **Figure 10** shows the distribution of employment sector and median annual salaries for respondents who held full-time employment.

Similar to last year, about two-thirds of the employed degree recipients indicated that some type of prior work experience assisted them in obtaining their current position. Previous employment experiences included non-departmental employment, summer positions, co-ops, internships, and assistantships.

Employed bachelors were asked to rate the extent to which they used skills they had acquired as undergraduates. Four of these skills related to the technical nature of their position, and combining them provided a rough measure of the technical nature of their work. When this measure was applied to those employed in the industrial sector, only 6% fell into a category that indicated positions with no technical involvement. This is half the proportion that fell into this non-technical category for the class of 1996. Included in that group are those working in the area of retail trade.

Figure 10. Employer distribution and median salaries for full-time US employed physics bachelors, class of 1996-97.



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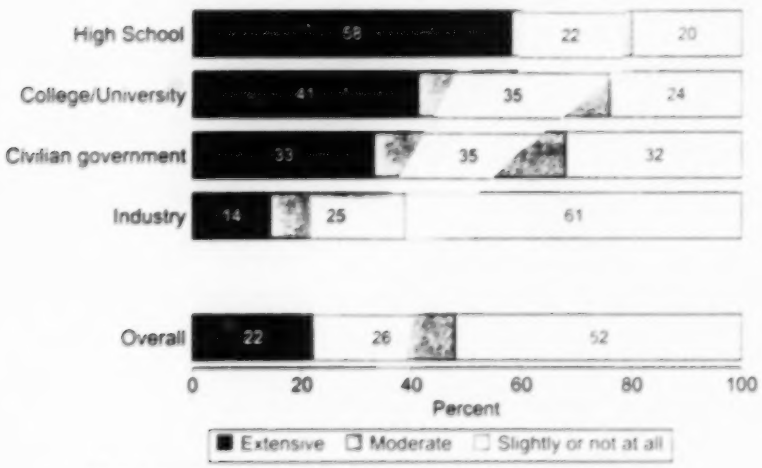
such as in sales and at restaurants, while others work in positions with job titles such as manager or operator. Although some individuals in these non-technical industry positions are well compensated, the median salary for this group is $25,000, well below the overall median salary for physics graduates in industry.

The majority (52%) of physics bachelors in the class of 1997 indicated that their jobs were only slightly or not at all related to physics (**see Figure 11**). This represents a modest increase from the 57% figure of the previous year. Degree recipients working in industry, the dominant sector for physics bachelors, were the least likely to be employed in physics-related positions. Conversely, more than half the individuals employed as high school teachers, at a college or university, or working in civilian government jobs were likely to hold a physics-related position. Individuals indicating prior work experience were more likely to obtain physics-related employment than those who did not.

When asked if they would still major in physics given the opportunity to do it over again, 88% of the bachelor's degree recipients indicated they would. The negative responses tended to come most frequently from individuals who were unemployed. Employed individuals working in positions that were only slightly or not at all related to physics were also more likely to indicate their dissatisfaction with their undergraduate degree.

The Statistics Division is conducting a study, titled *Bachelor's Plus Five*, which will develop detailed data on the education and employment histories of the physics bachelors class of 1991, 1992, and 1993. This report is scheduled to be completed in the early part of the year 2000.

Figure 11. Extent to which physics bachelors felt their US employment was physics related, class of 1996-97.



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Master's degree Recipients

For the 1996-97 academic year, physics departments reported that 789 students exited their department with a master's degree. This represents a large decline of 18% from the previous year's degree total. These degrees represent the final physics degree the student will receive from the department they were attending and do not include students who received a master's degree enroute to a physics doctorate in the same department. We were only able to obtain names and deliverable address information for about 600 of these masters, and we received usable responses from 218 in the winter following the academic year in which they received their degree. This low number limits the extent of the analysis that can be performed on this group.

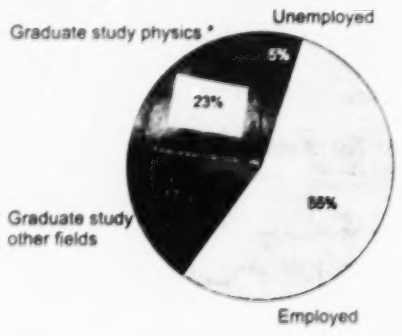
Post-degree outcomes for the class of 1997 physics master's is shown in **Figure 12**. According to the AIP Enrollments and Degrees Survey, the class of 1997 masters included 18% women and 36% foreign citizens. The proportion of respondents continuing with graduate study at a different department was 40%, an increase of 6% from the previous year.

Although an almost equal proportion of men and women chose to continue with graduate studies at another department or university, men were somewhat more likely to continue in physics than their female colleagues were. More prominent differences in post-degree outcomes are evident between the US foreign citizens **(see Table 2)**. About one-third of the US master's recipients, compared to almost three-quarters of the non-citizens, continued with their graduate studies in another department. Regardless of citizenship, students continuing with graduate studies were substantially more likely to pursue physics than another discipline. Engineering was the most frequently chosen discipline of students pursuing a field other than physics.

Over half of the physics master's entered the workforce after receiving their degree. Of these, 41% indicated having plans to return to graduate school in the future, most indicating a desire to return to studying physics. Industry continues to be the dominant employment sector for physics masters (see **Figure 13**), and those entering this sector received a median annual salary of $44,000.

Many students studying for a physics master's are employed while pursuing their degree. This year approximately one-quarter of the employed physics masters had been working in their current position prior to receiving their degree. This proportion is especially high for those working in the military. Overall, 75% of the employed masters indicate that their employment moderately or extensively related to the field of physics.

Figure 12. Post-degree outcomes of master's degree recipients, class of 1996-97.



* At a different university than which they received their masters

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Table 2. Post-degree outcomes of master's degree recipients, class of 1996-97.

	Citizenship	
	US %	Foreign %
Physics graduate study*	19	42
Graduate study in other field	13	30
Employment	62	26
Unemployed	6	2
	100%	100%

* At a different university than which they received their masters

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When asked if they would they still major in physics if they could do it over again, about 80% of the masters recipients indicated they would. Foreign citizens and inidivuals choosing to pursue graduate studies in other disciplines were more likely to indicate that they would not study physics again if given the opportunity. When asked why not, the majority of the responses centered on poor career and employment prospects.

Astronomy

During the 1996-97 academic year, US astronomy departments granted 117 PhDs, 23 master's degrees (not including degrees enroute to a PhD at the same department) and 177 Bachelors' degrees. The astronomy PhD recipients included 24% women and 22% foreign citizens. Among astronomy bachelor's degree recipients, 38% were women and only 4% were foreign citizens.

Initial employment patterns for new astronomy doctorates have remained very stable in recent years, with about two-thirds accepting postdoctoral positions. **Figure 14** shows initial employment for new astronomy PhDs by sector and type of position secured. This table excludes the 15% of the respondents who indicated they were working abroad. The median annual salary reported for individuals in postdoctoral appointments was $36,000, unchanged from the previous year. Only one responding astronomy doctorate recipient indicated that she was unemployed at the time the survey was conducted.

Approximately six months after the academic year in which they received their degree, 58% of the astronomy bachelor's recipients indicated they were pursuing graduate studies (**see Figure 15**). The majority of the students who entered graduate study choose to continue their studies in the fields of astronomy or astrophysics, and many

Figure 13. Employer distribution of full-time US employed physics master's, class of 1996-97.

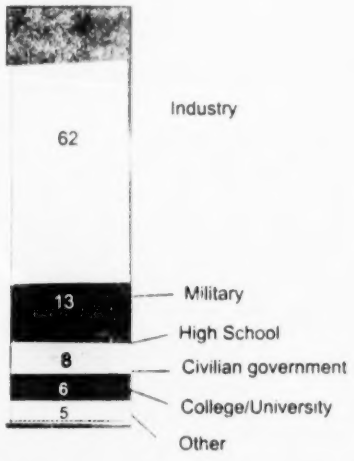

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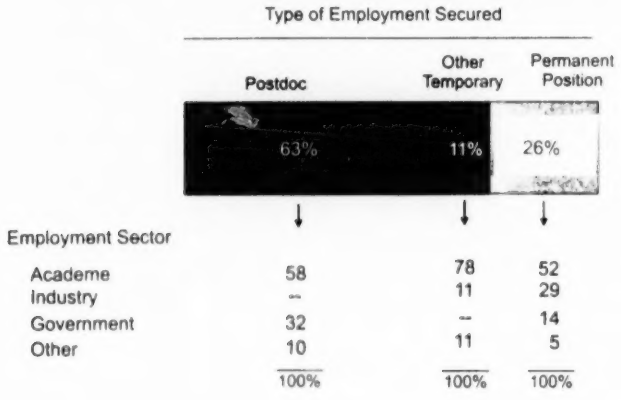
Figure 14. Astronomy PhD's type of US employment secured and employment sector, class of 1996-97.



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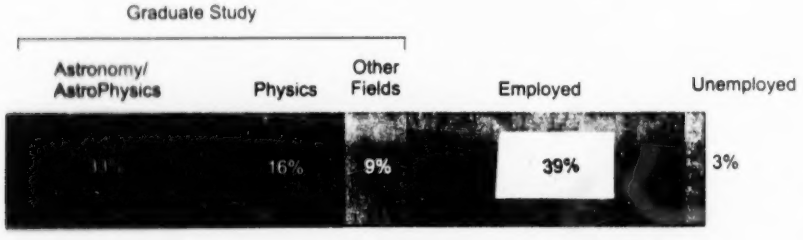
of the rest entered a physics program. Almost all the students entering graduate programs indicated they were full-time students and the majority were enrolled in a doctoral program.

As in the past, the majority (64% for the class of 1997) of the astronomy bachelors who entered the workforce were employed in industry. The bachelors employed in industry had a median salary of $38,000 and the most frequently cited work activities were engineering and computer related. About half (55%) of the employed astronomy bachelor's degree recipients indicated that their work was only slightly or not at all related to the fields of astronomy or physics.

Figure 15. Post-degree outcomes for astronomy bachelor's degree recipients, class of 1996-97.



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